GeoTimer 1999 GSA Annual Meeting -- Denver, Colorado

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Abstract 51153

CONSEQUENCES OF GLOBAL GLACIATION FOR THE MICROBIAL BIOSPHERE

Presented by Gaidos, Eric J..

Key words: evolution, precambrian, glaciation, biogeochemistry, mass-extinction

In Session 159 K5. Low-Latitude Precambrian Glaciation: Geochemical, Climatic, and Biological Effects of the Snowball Earth Wednesday, Wednesday, October 27, 1999 PM in Room: Ballroom 2 at 04:50 PM for 25 min .

Abstract: A 'snowball' Earth event would have led to a drastic reduction in the diversity of ecological niches and presumably mass extinction of species. Prokaryrotic and simple-single celled eukaryotes were the dominant organisms of the Precambrian, and the prokaryotes may have been the exclusive inhabitants of the Archean. Microbial life probably shaped and was shaped by global glaciations such as those proposed for the Paleoproterozoic and Neoproterozoic.

The mean thickness of pack ice(~ 1 km) would have prohibited photosynthesis and eliminated most marine primary productivity. In regions of ablation or ice fracturing, low levels of light may reach the water-ice interface, supporting local photosynthetically-based communities. The global ocean would become anoxic and hydrothermal circulation and biological sulfate reduction would have driven the entire water column to a reduced state, resulting in the collapse of both aerobic and anaerobic respiration-supportng cycles. Methanogenesis and acetogenesis would contiue to support a limited ecology in submarine volcanoes or hydrothermal systems. Freezing of the world ocean would result in interruption of the terrestrial hydrological cycle and atmospheric water transport would be effected only by sublimation and redeposition. Lacustrine environments would be destroyed either by freezing or ablation on a time scale of ~100 years. Liquid water would persist only if meltwater was supplied by the surroundings, possibly through the beds of glaciers. Continental hot spring waters are primarily of meteoric origin and their activity would be markedly decreased in the absence of rainfall. Further rigors (high temperature, acid rain, extreme weathering) await microbes at the end of the snowball. The Paleoproterozoic glaciation was also correlated with a rise in atmospheric oxygen levels toxic to many microorganisms.

The nature of prokaryotes make the fossil evidence for their evolution sparse and difficult to interpret. The evolution of genes reconstructed from the phylogenies of sequences present in extant organisms is intriguing, but not rigorous evidence. More substantial information on the global and local biochemistry of microganisms are found in measurements of stable isotope fractionation: The enormous excursions in the delta-C13 values through the carbonates of the glacially-associated Proterozoic formations hint at more exciting measurements to come.

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